The decay of the superdeformed band in ^{194}Pb: Electromagnetic Properties

R. Krücken, [1] *S.J. Asztalos,* [1] *J.A. Becker,* [3] *B. Busse,* [1] *R.M. Clark,* [1] *M.A. Deleplanque,* [1] *A. Dewald,* [2] *R.M. Diamond,* [1] *P. Fallon,* [1] *K. Hauschild,* [3] *I.Y. Lee,* [1] *A.O. Macchiavelli,* [1] *R.W. MacLeod,* [1] *R. Peusquens,* [2] *G.J. Schmid,* [1] *F.S. Stephens,* [1] *K. Vetter,* [1] *and P. von Brentano* [2]

[1] *Nuclear Science Division, Lawrence Berkeley National Laboratory, Berkeley, CA 94720, U.S.A.*

[2] *Institut für Kernphysik, Universität zu Köln, 50937 Köln, Germany*

[3] *Lawrence Livermore National Laboratory, Livermore, CA 94550, U.S.A.*

Lifetimes of the 14^+, 12^+, 10^+ states and, for the first time, the 8^+ state in the yrast superdeformed (SD) band of ^{194}Pb were measured at GAMMASPHERE (95 detectors) with the recoil-distance Doppler-shift method utilizing the Cologne Plunger. The reaction ^{164}Dy(^{34}S,4n) with a 166-MeV beam from the 88-Inch Cyclotron of the Lawrence Berkeley National Laboratory was used. 2×10^8 threefold and higher coincidence events recorded at 12 target-to-stopper distances between 2.6 and 1200 μ. The lifetimes of the 14^+, 12^+, 10^+ and for the first time the 8^+ SD states were determined (see Tab. I). Constant transition quadrupole moments with an average of 18.8 (11) e b were found at the bottom of the SD band.

The decay out of the SD band can be viewed as governed by a small admixture (a_n^2) of normal deformed (ND) states to the SD wavefunction which is assessed for the 8^+ and 10^+ SD states based on a simple mixing model (see Ref.[1] and refs. therein). The results ($a_n^2 \leq 1\%$) show that the structure of the SD states is not drastically changed. Spins and parity and the excitation energy of the SD states in ^{194}Pb were recently established [2, 3] by the observation of direct linking transitions between SD and near yrast ND states. The lifetimes of the 8^+ and 10^+ SD states and their branching ratios [3] determine the reduced transition probabilities for these discrete linking transitions. By correcting for the amount of admixture between SD and ND states one can extract the electromagnetic properties of the pure ND states that mix into the SD wavefunction. The extracted B(E1) values were found to be of the order of 10^{-6}-10^{-5} W.U. Upper limits of 3×10^{-2} W.U. for the B(E2) values and 5×10^{-4} W.U. for B(M1) values were determined. These values are all consistent with a statistical decay, even when the possibility of an increase by one order of magnitude is considered. They show no enhancement that would point to the presence of structural effects. Despite the large intensity of observed linking transitions, the new data show that the decay out of this SD band is statistical in nature.

Table 1: Mean lifetimes τ of SD states in the yrast SD band in ^{194}Pb. Reduced transition probabilities B(E2) and transition quadrupole moments Q_t are given for the intra-band transitions.

I^π	E_γ [keV]	τ [ps]	B(E2) 10^3 W.U.	Q_t [eb]
14^+	298	2.6±0.7	$1.8^{+0.8}_{-0.4}$	$18.5^{+3.2}_{-2.0}$
12^+	256	5.5±1.0	$1.7^{+0.3}_{-0.3}$	$18.2^{+1.9}_{-1.5}$
10^+	214	8.3±1.7	$2.2^{+0.6}_{-0.4}$	$20.7^{+2.5}_{-1.8}$
8^+	170	20.0±6.9	$1.5^{+0.7}_{-0.4}$	$17.3^{+4.0}_{-2.4}$

References

[1] R. Krücken *et al.*, Phys. Rev. C**54**, 1182 (1996)

[2] A. Lopez-Martens *et al.*, Phys. Lett. **B380**, 18 (1996)

[3] K. Hauschild *et al.*, to be published